

THE FLAGELLA OF *CYANOPHORA PARADOXA* KORSCH

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ABSTRACT

Both flagella of *Cyanophora paradoxa* are tinsel, resembling the Cryptophycean rather than the Dinophycean flagella. The organism appears to be an intermediate between the Cryptophyceae and the Dinophyceae.

UITTREKSEL

DIE FLAGELLA VAN *CYANOPHORA PARADOXA* KORSCH.

Beide flagella van *Cyanophora paradoxa* is van die flikkertipe en kom meer ooreen met die flagellum van die Cryptophyceae as met dié van die Dinophyceae. Die organisme is skynbaar intermediêr tussen die twee phyla.

INTRODUCTION

Cyanophora paradoxa Korschikoff is a unicellular alga traditionally classified into the Cryptophyceae (Family Cryptomonadineae). It is ovoid, truncated anteriorly and rounded posteriorly; the dorsal surface is convex, while the ventral surface is traversed by a longitudinal groove. The organism is 12-15 μm long, and 6-9 μm wide. Two trailing flagella inserted at approximately 120° , emerge in separate flagellar pits, and are 3-12 μm long (Figs. 1 & 2).

Originally classified by Korschikoff (1924), its affinities with the Cryptophyceae have been questioned (Korschikoff, 1941; Pringsheim, 1964). Mignot *et al.*, (1969), studying the ultrastructure, found Dinophycean and Cryptophycean features, indicating that the organism is an intermediate between the Dinophyceae and Cryptophyceae. The most conclusive Dinophycean feature found was the membrane-bound vesicles containing thecal plates, situated below the plasmalemma.

The ultrastructure of the flagellar surface was studied to see whether the flagella possessed Dinophycean or Cryptophycean features. The structure of the flagella differs markedly in the two groups. The Cryptophyceae have two tinsel flagella; the Dinophyceae have one whiplash flagellum while the other has a lateral expansion of the flagellar sheath ending in a striated strand. (Hibberd *et al.*, 1971; Leadbeater and Dodge, 1966.)

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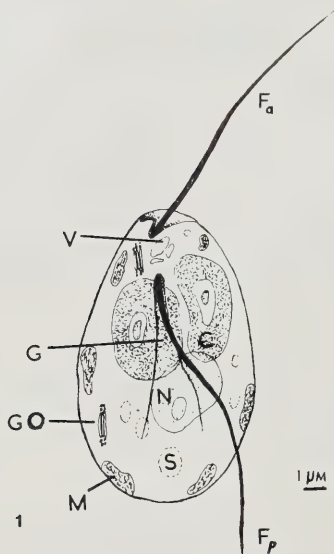


FIG. 1.

Whole cell of *Cyanophora paradoxa*. C = cyanelle containing thylakoids; N = nucleus; S = starch grain; V = pulsating vacuole; GO = Dictyosomes; M = mitochondrion; Fa = anterior flagellum; Fp = posterior flagellum; G = flagellar groove. (After Mignot *et al.*, 1969).



FIG. 2.

A scanning electron micrograph of *C. paradoxa*. G = flagellar groove; Fa = anterior flagellum; Fp = posterior flagellum. $\times 5\,500$.

MATERIALS AND METHODS

C. paradoxa was sub-cultured from the collection of the Botany Department, University of the Witwatersrand, and grown in Bolds 3N Bristols nutrient solution (Starr, 1966), using normal daylight illumination.

Two methods of fixation were used.

- (a) Cells were exposed to 1–2% O_3O_4 vapour for a few minutes, and washed in distilled water (modified from Loiseaux and West, 1970).
- (b) Cells were fixed in 1–2% O_3O_4 in Millonig's phosphate buffer at pH 7.3 for one hour at 4°C, dried onto grids, and washed in distilled water (Bradley 1965, 1966).

Two methods of preparation were used.

- (a) Fixed cells were dried onto carbon-stabilized formar grids, shadowed with carbon-platinum and gold-paladium at angles of 30–45°, and viewed under a Siemens Elmiskop I Electron Microscope. (Heath *et al.*, 1970).
- (b) Fixed cells were pipetted onto aluminium rivets, the rivets submerged in liquid nitrogen, vacuum dried for 10 hours at 5×10^{-5} torr, and gold coated. They were examined under a Cambridge Stereoscan Electron Microscope (Edwards and Black, 1971).

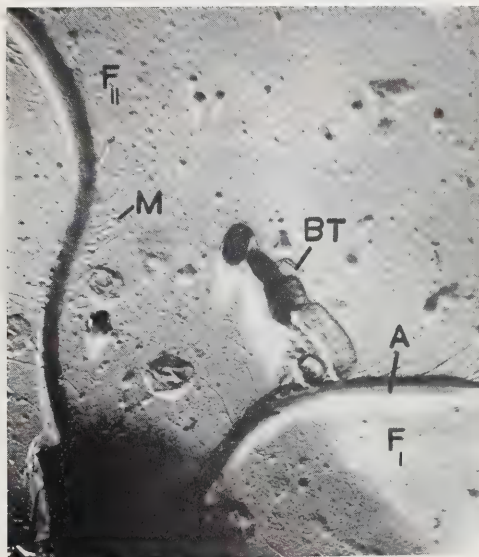


FIG. 3.

Part of a cell showing both flagella to be tinsel. M = mastigonemes; A = axoneme; F_I and F_{II} = flagella; BT = bacterial contamination. $\times 16\ 000$.

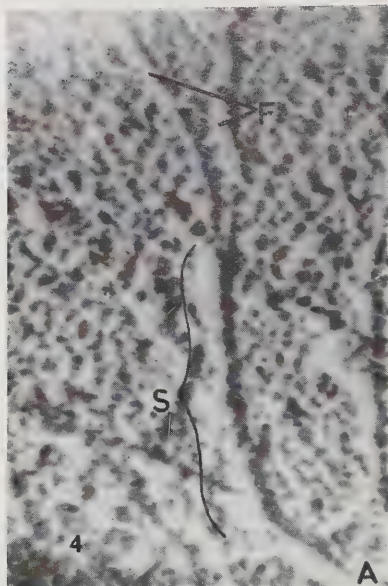


FIG. 4.

Proposed structure of a mastigoneme. S = main shaft; F = terminal filaments; A = axoneme.
 $\times 320\ 000$.



FIG. 5.

Tip of a flagellum showing tapering of the terminal axoneme into a "beak". A = axoneme;
 T = "beak"; M = mastigonemes. $\times 80\ 000$.

RESULTS AND DISCUSSION

Both flagella were tinsel, with a unilateral row of mastigonemes on both sides of the axoneme (Fig. 3). The mastigonemes appeared to have the same structure as found in the Cryptophyceae and Dinophyceae viz. a main shaft attached to the axoneme, and terminating in one to three filaments (Hibberd *et al.*, 1971) (Fig. 4). The axoneme tips often had a characteristic "beaked" structure (Fig. 5). No evidence was found of the Dinophycean flagellar structure.

This further supports the claim that the organism is an intermediate, which is of importance in algal phylogeny.

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